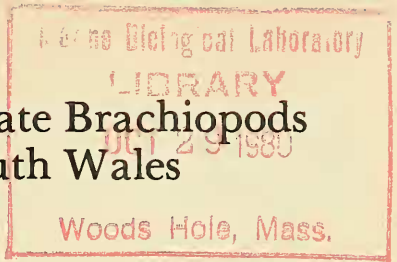


# Some Carboniferous Articulate Brachiopods from Eastern New South Wales

S. PEOU



PEOU, S. Some Carboniferous articulate brachiopods from eastern New South Wales. *Proc. Linn. Soc. N.S.W.* 104 (1), (1979) 1980:1-15.

Nine fossil localities in the Carboniferous Berrico Creek Formation at Berrico-Rawdon Vale and an unnamed formation at Brownmore in eastern New South Wales, have yielded a number of new brachiopod taxa belonging to the *Rhipidomella fortimuscula* Zone. Among these taxa are *Quadratia engeli* sp. nov., *Q. boonienensis* sp. nov., Productoid gen. et sp. nov., *'Camarotoechia' subtrigonalis* sp. nov., *Schizophoria subelliptica* sp. nov., *Podtsheremia fasciculata* sp. nov., and *Brachythyris cobarkensis* sp. nov. They are short-ranging species and hence are suitable as zonal index fossils.

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## INTRODUCTION

The *Rhipidomella fortimuscula* Zone is one of nine major brachiopod zones in the Carboniferous of eastern Australia (Campbell and McKellar, 1969; Campbell and Roberts, 1969; Jones *et al.*, 1973; Roberts, 1975; Roberts *et al.*, 1976). The fauna of this zone was first studied by Cvancara (1958) and then by Campbell and McKelvey (1972) from the Barrington District, New South Wales. McKellar (1967) and Driscoll (1960) recognized this fauna from the Yarrol Trough, Queensland.

Over the past twenty years, a large number of brachiopod genera and species have been described from the *Rhipidomella fortimuscula* Zone, many of them are short-ranging forms and clearly indicative of a late Viséan age (Roberts, 1975, 1976). Recent work on rocks of this age in the Berrico Creek Formation at Berrico-Rawdon Vale (Whitford, 1971; Peou, 1977) and an unnamed formation at Brownmore (McDonald, 1972; Roberts, 1975) (Fig. 1), has resulted in discrimination of several new taxa. Good stratigraphical control and short ranges suggest that these taxa may

	BERRICO-RAWDON VALE	BROWNMORE	BRACHIOPOD ZONES/SUBZONES	
CARBONIFEROUS	CUT HILL FORMATION	BOORAL FORMATION		
	FAULKLAND FORMATION 7A	UNNAMED SANDSTONE	7A	<i>Linoproductus</i> [ <i>Balakhonia</i> ]rawdonvalensis
	BERRICO CREEK FORMATION 7 6	UNNAMED FORMATION 6	7	<i>Marginirugus barringtonensis</i>
		6?	6	<i>Rhipidomella fortimuscula</i>
	CARSONVILLE FORMATION	FLAGSTAFF SANDSTONE	5B	<i>Gigantoproductus tenuirugosus</i> <i>Delepinea</i>
			5A	<i>Inflatia elegans</i> <i>aspinosa</i>
	WOOTTON BEDS 5	BONNINGTON SILTSTONE		
	ARARAT FORMATION			

Fig. 1. Correlation of Carboniferous formations of the Berrico-Rawdon Vale and Brownmore districts, N.S.W. The brachiopod zones/subzones are indicated by numbers on the right hand side of columns (Modified from Roberts, 1975; Peou, 1977; and Peou and Engel, 1979).

be useful for zonal identification. They include two species of *Quadratia*, one species each of '*Camarotoechia*', *Schizophoria*, *Podtsheremia* and *Brachythyris*; one productoid described on the basis of only three specimens has been temporarily designated as a new genus and species.

The descriptions of these brachiopods are based on collections housed in the Department of Geology, University of Newcastle, New South Wales. The fossils have been obtained from nine localities in the Berrico-Rawdon Vale-Brownmore region, N.S.W. (Fig.2). Details of these localities (locality number, grid references and name of the topographic sheets) are given at the end of the paper.

#### SYSTEMATIC DESCRIPTION

##### Superfamily PRODUCTACEA

##### Family PRODUCTELLIDAE Schuchert & LeVene 1929

##### Subfamily CHONOPECTINAE Muir-Wood & Cooper 1960

##### Genus *QUADRATIA* Muir-Wood & Cooper 1960

*Type species: Productus hirsutiformis* Walcott 1884.

*Remarks:* The specimens described below differ from those of *Quadratia* from the Mississippian rocks of Oklahoma and Nevada, in having a weak ventral sulcus and dorsal fold, better developed prostrate spines on the ventral visceral disc, faintly dendritic adductor scars, broader and flat lateral ridges in the brachial valve, and a pronounced adductor platform in the same valve. In addition, the present specimens are characterized by their bilobed cardinal process whose lobes are incised and

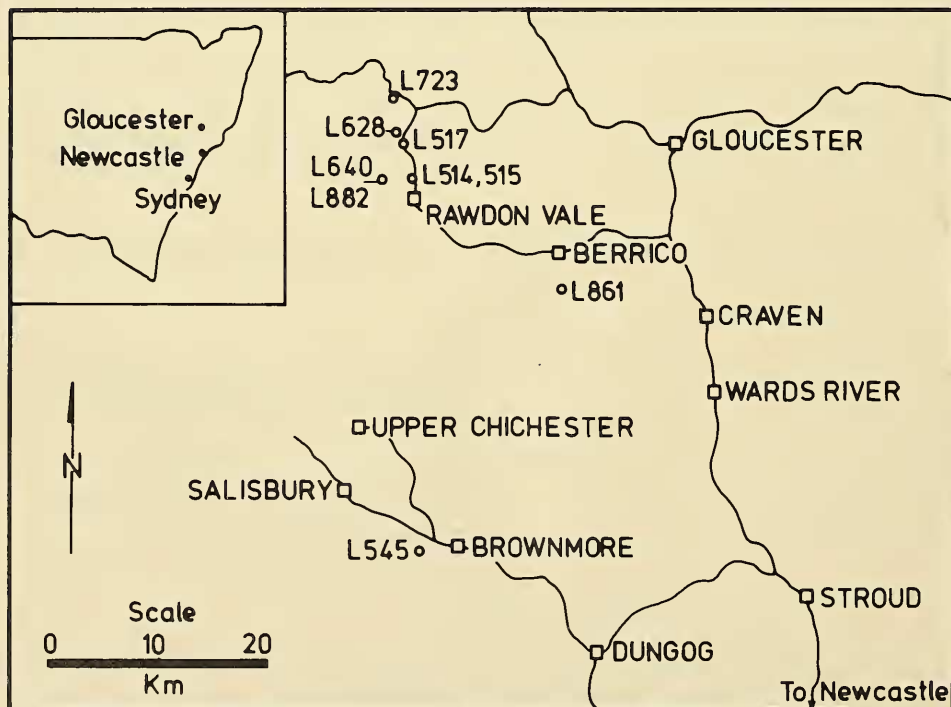


Fig. 2. Fossil locality map of the Berrico-Rawdon Vale and Brownmore districts, N.S.W.

separated by a distinct median depression, instead of a knoblike process observed in *Quadratia*, but described by Muir-Wood and Cooper (1960, p.161) as probably incomplete. Most of these differences could be of generic significance, however it would be better to await further knowledge of the type species of *Quadratia*, before separate generic status is given to the present material.

*Quadratia engeli* sp. nov.

Fig. 3, 1-7

*Material*: NUF 4049-4057, 4355; holotype NUF 4053, paratypes NUF 4049, 4054-4057, all from NUL 640 (the type locality) in the Berrico Creek Formation at Rawdon Vale.

*Derivation of name*: In honour of Associate Professor B.A. Engel, Department of Geology, University of Newcastle, N.S.W.

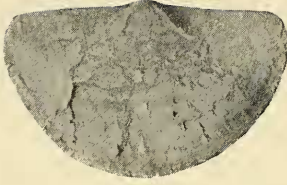
*Diagnosis*: A species of *Quadratia* characterized by having a distinct sulcus and fold, prostrate spines on ventral visceral disc and suberect to erect spines scattered on trail, a diamond-shaped dorsal adductor platform, a conspicuous brevisseptum, and a moderate cardinal process with a median depression.

*Description*: *Exterior*. Shell medium-sized, transverse, widest at straight hinge; interareas bearing fine striations; ears broad and flattened. Pedicle valve with a convex visceral disc and a short trail; umbo small, overhanging hinge; valve surface bearing faint concentric growth lines and weak rugae; prostrate spines rare, suberect to erect spines not arranged in rows on trail. Brachial valve with a concave visceral disc and a steep trail; interarea narrower than that of the pedicle valve; concentric growth lines and rugae well developed.

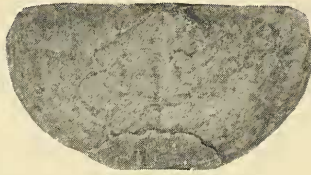
*Interior*. Pedicle valve having an elliptical cavity of visceral disc well demarcated from impressions of external ears; anterior adductor scars either pear-shaped or elongate, elevated, placed between shallowly depressed posterior adductor scars; a shallow furrow separating adductor scars, and bearing a median ridge; diductor scars teardrop-shaped in outline, ridged anteriorly and smooth posteriorly, enclosing adductor scars; a large shell thickening situated posterior to muscle field; two ridges borne near elongate hinge teeth, diverging at  $16^{\circ}$  from hinge. Brachial valve with an elevated adductor platform having a median depression; adductor scars weakly dendritic, spreading from the depression to lateral slopes of platform, bounded posterolaterally by two heavy ridges supporting cardinal process and diverging at  $38^{\circ}$ - $40^{\circ}$  from hinge; anterior adductor scars broad, embracing small triangular posterior adductor scars; brevisseptum non-sulcate, arrow-headed, dividing adductor scars; cardinal process with two high lobes shallowly incised; a weak median ridge defined in deep depression separating the two lobes, detached from brevisseptum by a small alveolus; sockets deep, bounded anteriorly by short socket ridges; narrow furrows separating these ridges from lobes of cardinal process; lateral ridges broad and flat, attached to socket ridges, following hinge margin, and dying out before reaching cardinal extremities.

*Measurements*: Length of shell: 18.5mm-25.5mm; width of shell: 36mm-44mm.

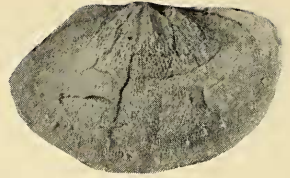
*Remarks*: *Quadratia egregia* Carter (1967) from the Mississippian Chapel Limestone of central Texas, U.S.A., is similar to the present species in the presence of ventral sulcus and dorsal fold. However, Carter's species has smaller ears, overlapping growth lamellae and small spine bases in concentric rows on the pedicle valve, small closely set flattened teeth, and a lower bifid cardinal process supported by a narrow median septum. The Mississippian species *Q. hirsutiformis* (Walcott) redescribed by Muir-Wood and Cooper (1960) from Oklahoma and Nevada, differs from *Q. engeli* in having stronger concentric growth lines and rugae, a more transverse cavity of the ventral visceral disc, thicker but shorter ridges arising near hinge teeth, a thinner brevisseptum being not arrow-headed and originating from a low smooth platform,



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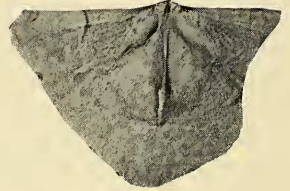
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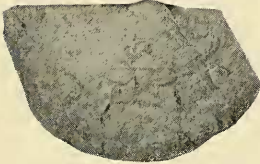
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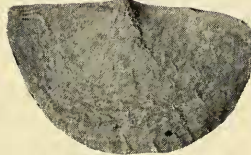
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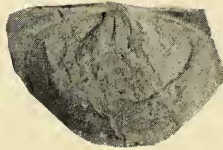
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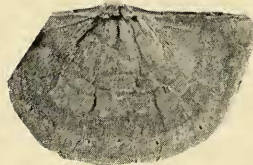


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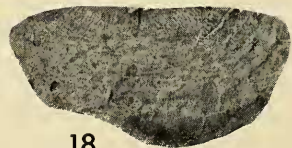
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and weaker ridges bounding the dorsal adductor scars postero-laterally. *Q. rangariensis* (Campbell, 1963) from the Tournaisian rocks of the Werrie and Belvue Synclines, N.S.W., has more numerous spines on the pedicle valve, broader but shorter adductor scars and smaller diductor scars in the same valve. The brachial valve of *Q. rangariensis* has a non-arrow-headed brevisseptum developed from a flat to rounded posterior platform, and has undivided smooth adductor scars bordered postero-laterally by two short ridges arising from the central platform.

*Quadratia booniensis* sp. nov.

Fig.3, 8-18

*Material*: NUF 4037-4048; holotype NUF 4044, paratypes NUF 4045 and 4047, all from NUL 640 (the type locality) in the Berrico Creek Formation at Rawdon Vale.

*Derivation of name*: After Boonie Doon farmhouse at Rawdon Vale.

*Diagnosis*: A species of *Quadratia* having very distinct prostrate spines, suberect to erect spines in rows on ventral trail, a low dorsal platform, a thin brevisseptum, and a small cardinal process with a shallow median depression.

*Description*: *Exterior*. Shell medium-sized, transverse, with a maximum width at straight hinge; interareas flat, horizontally striated; ears subtriangular, flattened. Pedicle valve with a gently convex visceral disc and a short trail; umbo small, incurved over hinge; valve smooth on trail, bearing poorly developed concentric growth lines and rugae elsewhere; 7-8 spines on one row on trail, 2-3 spines defined on hinge margin. Brachial valve with a weakly concave visceral disc and a steep trail; interarea narrower than that of the pedicle valve; valve surface bearing prominent growth lines and rugae.

*Interior*. Pedicle valve having an elliptical cavity of visceral disc well separated from impressions of external ears; adductor muscle field heart-shaped in outline; anterior adductor scars slightly elevated, faintly dendritic, inserted between smooth posterior adductor scars; a furrow dividing adductor scars; a weak ridge extending on floor of the furrow near posterior end of muscle field or from a shell thickening in one specimen to a short distance from anterior ends of adductor scars; diductor scars teardrop-shaped, either smooth or faintly ridged; two distinct ridges arising in front of small and sharp hinge teeth, diverging at 14°-15° from hinge, being curved and obsolete along inner edges of ears. Brachial valve with a gently elevated adductor platform having a shallow median depression with a sharp brevisseptum being obscure between adductors scars not clearly separated; a faint median ridge sitting in shallow depression between two incised lobes of cardinal process; two short but robust ridges supporting the process, diverging at 32°-34° from hinge; alveolus ill-defined; sockets deep, elongate; socket ridges developed from lobes of cardinal process by narrow furrows, lateral ridges broad and flat, running along hinge margin, fusing on ears.

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*Fig. 3.* 1-7. *Quadratia engeli* sp. nov. 1. Latex cast of a pedicle valve exterior; NUF 4049, paratype, x1. 2. Latex cast of an incomplete pedicle valve exterior showing a sulcus; NUF 4051, x1.5. 3. External mold of a brachial valve; NUF 4052, x1.1. 4-5. Internal mold of two pedicle valves; NUF 4055 and 4053, both paratypes, x1.1 and x1.5 respectively. 6. Latex cast of an incomplete brachial valve interior; NUF 4047, holotype, x1.3. 7. Enlargement of NUF 4047 showing a bilobate cardinal process whose incised lobes are separated by a median depression bearing a distinct ridge, x3. All from NUL 640, Rawdon Vale.

8-18. *Quadratia booniensis* sp. nov. 8-9. Latex cast of two pedicle valve exteriors; NUF 4038 and 4037, both x1. 10. External mold of an incomplete brachial valve; NUF 4041, x1. 11. Latex cast of NUF 4041, x1. 12. Internal mold of a pedicle valve; NUF 4045, paratype, x1.1. 13. Latex cast of NUF 4045, x1. 14. Internal mold of a pedicle valve; NUF 4044, paratype, x1. 15. Latex cast of NUF 4044, x1. 16. Latex cast of an incomplete brachial valve interior; NUF 4057, holotype, x1.5. 17. Enlargement of NUF 4057 showing a bilobate cardinal process with incised lobes separated by a median depression, x4.2. 18. Latex cast of an incomplete brachial valve interior; NUF 4355, x1.5. All from NUL 640, Rawdon Vale.

*Measurements:* Length of shell: 18.5mm-25.5mm; width of shell: 31mm-44mm.

*Remarks:* *Quadratia booniensis* is similar to *Q. engeli* mainly in the size and the shape of the shell, straight hinge, striated interareas, flattened ears, tear-drop outlines of ventral diductor scars, broad lateral ridges and incised lobes of the cardinal process. However, *Q. engeli* differs in having distinct sulcus and fold, less developed prostrate spines on the visceral disc and scattered suberect to erect spines not arranged in rows on the trail of the pedicle valve, elongate ventral adductor scars, a better developed dorsal adductor platform, a thicker and arrow-headed brevisseptum, a stronger cardinal process supported on two heavier ridges, and a deeper median depression separating the two lobes of the process. *Q. hirsutiformis* (Walcott) redescribed by Muir-Wood and Cooper (1960) possesses a more pronounced concentric ornament, a more transverse cavity of ventral visceral disc, deeply impressed ventral adductor scars, a better developed alveolus, a shorter brevisseptum springing from a smooth platform, and weaker ridges supporting the cardinal process. *Q. egregia* Carter (1967) is characterized by having distinct sulcus and fold, developed overlapping growth lamellae, several small spine bases on each side of ventral umbo close to posterior margin, closely set flattened teeth, and a narrow median septum supporting the cardinal process. The only other comparable species, *Q. rangariensis* (Campbell, 1963), has strongly developed spines on the pedicle valve, suboval to subtriangular ventral adductor scars being slightly embraced by the small diductor scars, a broad posterior dorsal platform from which arises a more distinct brevisseptum, and weaker and shorter ridges bounding dorsal adductor scars.

Family DICTYOCLOSTIDAE Stehli 1954  
Subfamily DICTYOCLOSTINAE Stehli 1954  
PRODUCTOID gen. et sp. nov.

Fig. 4, 1-6

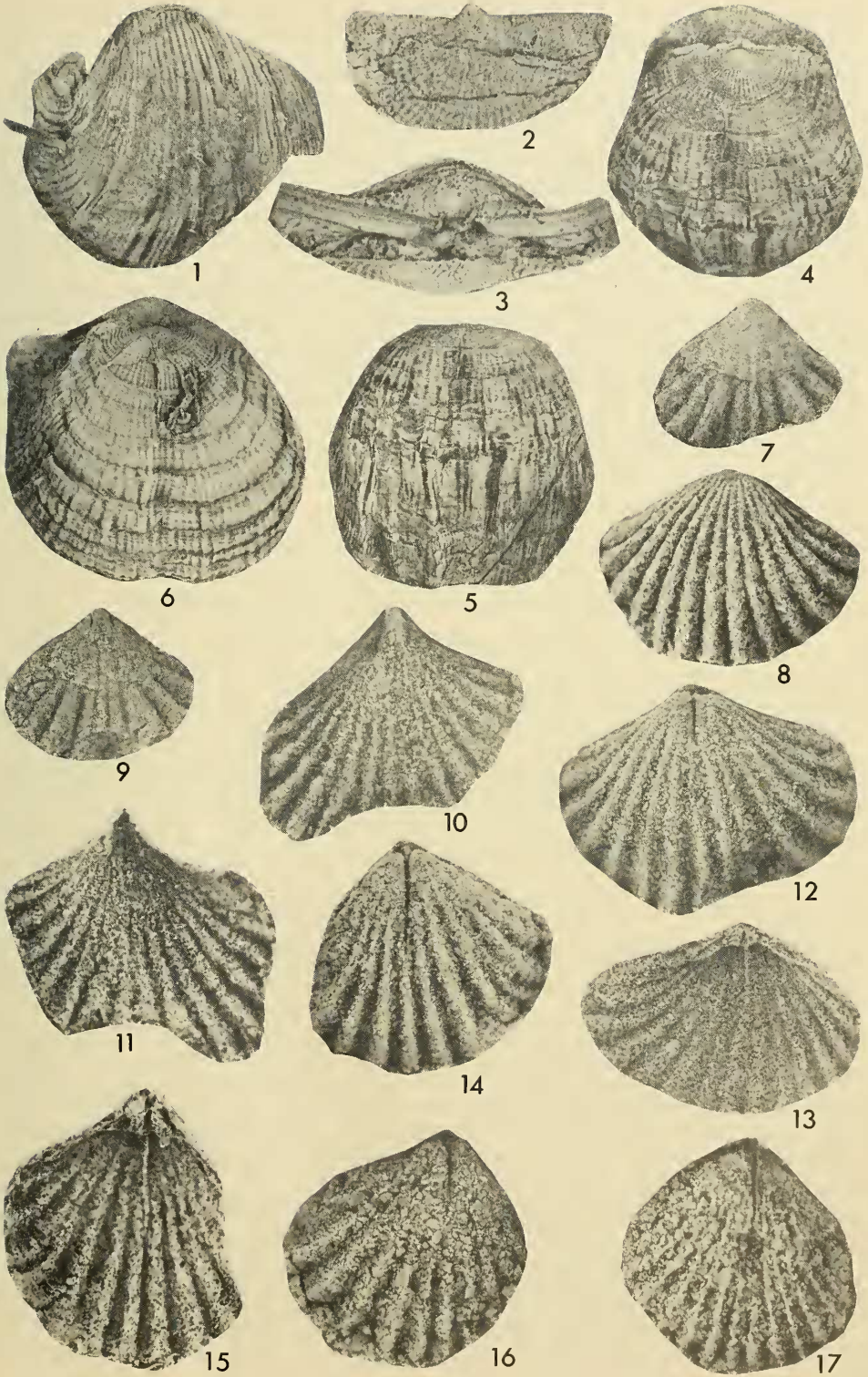
*Material:* NUF 4021-4023, all from NUL 545 in the unnamed formation at Brownmore.

*Description: Exterior.* Shell large, concavo-convex; hinge line short; interareas concave; ornament of costae forming a reticulation with weak concentric ridges on umbonal region, broad concentric lamellae (on brachial valve only), growth lines and spines. Pedicle valve with a small umbo, a shallow sulcus, a broad visceral disc and a long trail; costae subrounded to flat, branching, curved posteriorly on steep lateral slopes, and wrapping high knoblike structures on small ears; spines suberect to erect, big and long. Brachial valve with a short umbo, a low fold, and small ears bearing deep depressions for the reception of knoblike structures on ventral ears; costae

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*Fig. 4.* 1-6. Productoid gen. et sp. nov. I. Latex cast of a pedicle valve exterior; note the distinct knoblike structure on one ear; NUF 4021, figured specimen, x0.8. 2. Latex cast of an incomplete pedicle valve exterior; NUF 4023, x1.6. 3. Latex cast of a cardinal area and umbonal regions of pedicle valve and brachial valve exteriors; NUF 4023, x2. 4-5. External mold of a brachial valve showing the broad visceral disc (4) and trail (5); NUF 4023, x0.9 and x0.8 respectively. 6. External mold of a brachial valve; note the distinct reticulate and lamellose ornament; NUF 4022, figured specimen, x0.9. All from NUL 545, Brownmore.

7-17. '*Camarotoechia*' *subtrigonalis* sp. nov. 7. Latex cast of a pedicle valve exterior; NUF 4059, x3. 8. Latex cast of a brachial valve exterior; NUF 4058, x2.6. 9-10. Internal mold of two pedicle valves; NUF 4062 and 4061, both paratypes, x2.8 and x3.5 respectively. 11. Latex cast of NUF 4061, x4. 12. Internal mold of a brachial valve; NUF 4066, holotype, x4.5. 13. Latex cast of NUF 4066, x3.5. 14-15. Internal mold of a brachial valve and latex cast of same; NUF 4065, paratype, x4.5 and x4.9 respectively. 16-17. Internal mold of two brachial valves; NUF 4067, paratype and NUF 4068, x4.2 and x5 respectively. All from NUL 723, except NUF 4059 and 4062 from NUL 882, Rawdon Vale.



rounded, increasing by intercalation; big spines rare, faint spines on long trail. Internal structures of both valves unknown.

*Measurements:* Length of shell: 43mm-51mm; width of shell: 52mm-56mm.

*Remarks:* Only three specimens are at present available for the description. The brachial valve exhibits three different ornamental zones: (a) a reticulate zone occupying the umbonal region and being produced by the intersection between concentric ridges and radial costae; (b) a lamellose zone situated between the other two, covering over 80% of valve surface, and bearing concentric lamellae with growth lines interrupting the radial costae, and rare spines; and (c) a narrow spinose zone on trail, bearing fine spines.

Determination of the generic affinities of the species described above is difficult, due to the lack of specimens detailing the internal structures. This form is referred to the subfamily Dictyoclostinae only on the basis of its reticulate umbonal region and costate trail. A precise assignment must await detailed study of further material. The external ornamentation of the brachial valve, especially the broadly developed concentric lamellae traversing the radial costae, and the knoblike structures on the ears of the pedicle valve are the most distinctive features which could separate the present genus from all other productid genera.

#### Superfamily RHYNCHONELLACEA

##### Family CAMAROTOECHIIDAE Schuchert & LeVene 1929

##### Subfamily CAMAROTOECHIINAE Schuchert & LeVene 1929

##### Genus *CAMAROTOECHIA* Hall & Clarke 1893

*Type species:* *Atrypa congregata* Conrad 1841.

*Remarks:* Numerous workers have recorded species of *Camarotoechia* from the Devonian and Carboniferous of Australia. The genus has yet to be unequivocally recorded from the southern hemisphere, or for that matter from Carboniferous rocks, so the following species, a more strongly-ribbed form than the type species *C. congregata* (Conrad, 1841), is referred to the genus as a procedural gambit until such time as the systematics of Australian Devonian and Carboniferous rhyntonellaceans are better known.

##### '*Camarotoechia*' *subtrigonalis* sp. nov.

Fig. 4, 7-17

*Material:* NUF 4058-4070; holotype NUF 4066, paratypes NUF 4061, 4062, 4065 and 4067, from NUL 723 (the type locality) and 882 in the Berrico Creek Formation at Rawdon Vale.

*Derivation of name:* *subtrigonalis* refers to the not completely trigonal shell outline.

*Diagnosis:* A species of '*Camarotoechia*' with a small and plicate shell being subtrigonal in outline, a feebly uniplicate anterior commissure, a V-shaped dorsal septalium supported by a short median septum, and an unsplit to split hinge plate bearing two short crura.

*Description: Exterior.* Shell unequally biconvex, generally wider than long, ornamented with coarse rounded costae. Pedicle valve moderately convex; umbo slightly incurved; sulcus distinct, shallow, commencing in front of umbo, having 3 to 5 plicae; lateral slopes not steep, 4-6 plicae on each slope; concentric growth lines poorly developed. Brachial valve more convex than pedicle valve; umbo strongly incurved; fold low, having 4 plicae; lateral slopes steep, each slope bearing 5-6 plicae.

*Interior.* Pedicle valve with ill-defined adductor scars, smooth elongate diductor scars



tapering posteriorly and sitting between two short and sharp dental lamellae; diverging angle of the lamellae  $28^{\circ}$ - $34^{\circ}$ ; teeth strong, supported on dental lamellae. In brachial valve, adductor scars smooth, separated by a sharp median septum extending about one-half total length of valve; septalium shallow; sockets deep and elongate, bounded posteriorly by outer edges of hinge plate.

*Measurements*: Length of shell: 6mm-12.5mm; width of shell: 7mm-15mm.

*Remarks*: '*Camarotoechia*' *subtrigonalis* is similar to *C. sp.* Campbell (1957) and *C. sp. A* Roberts (1963) respectively from Babbinboon and Lewinsbrook, N.S.W., particularly in the shape and size of the shell, and the number of plicae in the ventral sulcus. *C. sp.* differs from the described species in the possession of longer dental lamellae and developed rays on crura. *C. sp. A* has a more transverse shell, fewer plicae on dorsal lateral slopes, a shorter median septum and narrower sockets in the brachial valve. *C. sp. B* Roberts (1965) from Trevallyn, N.S.W., is characterized by a larger, subequally biconvex shell ornamented with angular plicae on the lateral slopes, a globular to rounded brachial valve, and a shorter dorsal median septum. In addition, *C. amnica* and *C. septima* Veevers (1959) respectively from the Carnarvon and Bonaparte Gulf Basins, Western Australia, have a pentagonal shell, a deeper ventral sulcus with fewer plicae, and a weaker dorsal median septum.

#### Superfamily ENTELETACEA

#### Family ENTELETIDAE Waagen 1884

#### Subfamily SCHIZOPHORIINAE Schuchert & LeVene 1929

#### Genus *SCHIZOPHORIA* King 1850

*Type species*: *Conchyliolithus (Anomites) resupinatus* Martin 1809.

*Schizophoria subelliptica* sp. nov.

Fig.5, 1-7

*Material*: NUF 3825-3847; holotype NUF 3839, paratypes NUF 3829-3831, 3840-3842, all from NUL 514 (the type locality) in the Berrico Creek Formation at Rawdon Vale.

*Derivation of name*: *subelliptica* refers to the not completely elliptical shell outline.

*Diagnosis*: A species of *Schizophoria* with a subelliptical shell outline, ventral adductor scars on a high elevation and deeply depressed diductor scars, strong pallial markings, and two subparallel main pallial trunks arising at anterior ends of ventral adductor scars.

*Description*: *Exterior*. Shell transverse, widest at about midlength; cardinal extremities well rounded; hinge about two-thirds to four-fifths maximum width of shell; capillae rounded, increasing by both intercalation and bifurcation, numbering 40 per 10mm on anterior median portion of shell; growth lines developed, spine bases not observed. Pedicle valve convex on umbonal region, concave anteriorly; beak small and short; lateral slopes steep; sulcus shallow, not reaching umbo; interarea broad; delthyrium open, triangular, as wide as high. Brachial valve strongly convex; lateral slopes very steep; fold indistinct; cardinal extremities gently concave; interarea narrow, bearing faint horizontal striations; notothyrium slightly wider than high.

*Interior*. Pedicle valve with robust dental plates bordering muscle field laterally and diverging at  $58^{\circ}$ - $64^{\circ}$ ; teeth strong; diductor scars tapering posteriorly, either smooth or weakly striated, adductor scars smooth, narrowly elongate, sitting on flanks of a heavy longitudinal elevation; a shallow furrow defined on the elevation in some specimens, dividing adductor scars; vascula genitalia on anterior and lateral sides of

muscle field. In brachial valve, brachiophores projecting from either side of notothyrial cavity, diverging at  $62^{\circ}$ - $76^{\circ}$ ; sockets elongate, with a subrounded floor bearing transverse grooves which extend to distinct fulcral plates; cardinal process consisting of a high median lobe and two lateral lobes separated by deep furrows; lamellose myophores developed in the process; anterior adductor scars shallowly depressed, separated from small posterior adductor scars by two low broad ridges; adductor scars finely striated; a large swelling concave posteriorly, located between adductor scars, bearing a rounded median ridge; postero-lateral sides of muscle field pustulose; two main parallel trunks branching anteriorly, arising either from anterior ends of posterior adductor scars or from the broad ridges separating the anterior and posterior adductor scars; another two subparallel trunks borne at anterior ends of anterior adductor scars; secondary pallial markings prominent in both valves.

*Measurements*: Length of shell: 19.5mm-27.5mm; width of shell: 26.5mm-33mm.

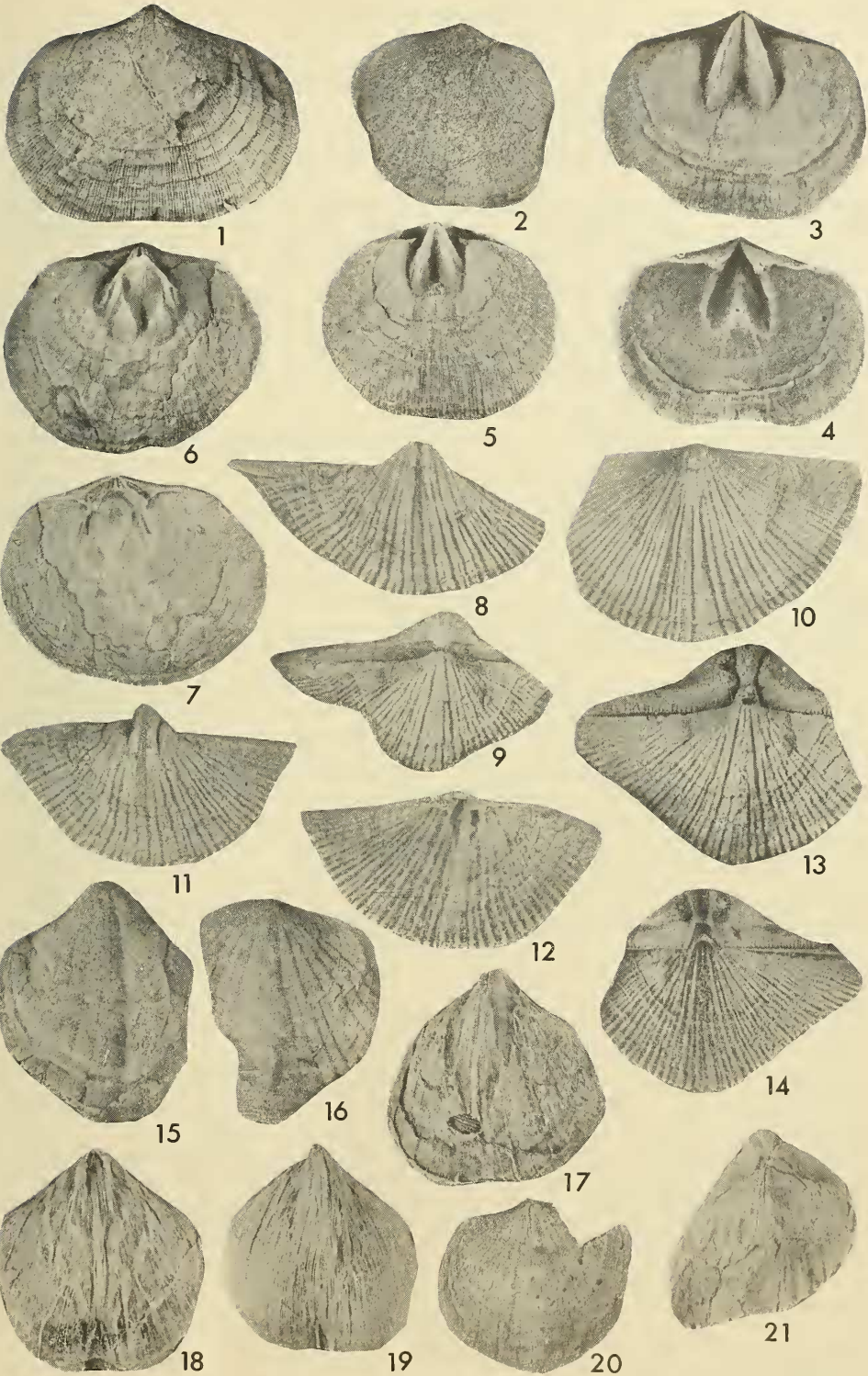
*Remarks*: *Schizophoria subelliptica* resembles *S. verulamensis* Cvancara (1958) from Barrington, N.S.W., in the shape of the shell, and subparallel pallial trunks defined in the pedicle valve. It is distinguished from Cvancara's species by its more numerous capillae, smaller diverging angles of dental plates and brachiophores, narrower ventral adductor scars, better developed secondary pallial markings, sockets and fulcral plates bearing transverse grooves, and trilobate cardinal process containing lamellose myophores. *S. sp. cf. S. resupinata* (Martin) described by Roberts (1971) from Bonaparte Gulf Basin, northwestern Australia, differs from the present species in having a shorter hinge, a broader ventral muscle field, a larger dorsal median swelling, a larger diverging angle of the brachiophores, and a single to multi-lobed cardinal process. *S. resupinata* (Martin) described by Sarycheva *et al.* (1963) and *S. altaica* Besnossova (1968) respectively from Kuznetsk Basin and eastern Kazakhstan, U.S.S.R., have a longer hinge and a less convex brachial valve. In addition, *S. resupinata* has fewer radial ribs, a weak dorsal median furrow, broader ventral muscle scars and stronger dorsal brachiophores; *S. altaica* is larger and has a rounded shell, an almost flat pedicle valve and no developed ventral sulcus and dorsal fold. Two species, *S. antiqua* Solle and *S. striatula* (Schlotheim), described by Pocock (1966) from the Devonian rocks of Germany, are characterized by having an elliptical to quadrate shell with a better developed radial ornament, an angular dorsal median septum, and fewer main pallial trunks in the brachial valve. Also, *S. antiqua* is smaller and possesses broader ventral muscle scars and oval dental sockets; *S. striatula* exhibits stronger ventral sulcus and dorsal fold, and better developed myophores.

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*Fig. 5. 1-7. Schizophoria subelliptica* sp. nov. 1. Latex cast of a pedicle exterior; NUF 3825, x1.6. 2. Latex cast of a brachial valve exterior; NUF 3827, x2.2. 3. Internal mold of a pedicle valve; NUF 3832, x1.2. 4. Latex cast of NUF 3832, x1.3. 5. Internal mold of a pedicle valve; NUF 3831, paratype, x1. 6. Internal mold of a brachial valve; NUF 3839, holotype, x1.1. 7. Latex cast of NUF 3839, x1.2. All from NUL 514, Rawdon Vale.

8-14. *Podtsheremia fasciculata* sp. nov. 8. Latex cast of a pedicle valve exterior; NUF 4152, paratype, x2. 9. Latex cast of a brachial valve exterior with an apical portion of pedicle valve exterior; NUF 4151, paratype, x1.7. 10. Latex cast of a brachial valve exterior; NUF 4155, x2. 11. Internal mold of a pedicle valve; NUF 4157, x1.7. 12. Latex cast of NUF 4157, x1.9. 13. Internal mold of a brachial valve and a posterior portion of pedicle valve; NUF 4341, holotype, x1.5. 14. Latex cast of NUF 4341, x1.6. All from NUL 628, Rawdon Vale, except NUF 4155 from NUL 861, Berrico.

15-21. *Brachythyris cobarkensis* sp. nov. 15. Latex cast of a pedicle valve exterior; NUF 4225, x2.1. 16. Latex cast of a brachial valve exterior; NUF 4226, x1.7. 17-19. Internal mold of three pedicle valves; NUF 4231, paratype, x1; NUF 4234, holotype, x1; and NUF 4233A, x1.1. 20. Internal mold of a brachial valve; NUF 4243, paratype, x1.1. 21. Internal mold of a brachial valve with a posterior portion of pedicle valve; NUF 4232B, paratype, x1. All from NUL 517, except NUF 4226, 4243 and 4232 B from NUL 515, Rawdon Vale.



## Superfamily SPIRIFERACEA

## Family SPIRIFERIDAE King 1846

Genus *PODTSHEREMIA* Kalashnikov 1966

*Type species: Podtsheremia prima* Kalashnikov 1966

*Podtsheremia fasciculata* sp. nov.

Fig. 5, 8-14

*Material:* NUF 4341, 4151-4152, 4155, 4157; holotype NUF 4341, paratypes NUF 4151, 4152, from NUL 628 (the type locality) in the Berrico Creek Formation at Rawdon Vale, and NUL 861 in the same formation at Berrico.

*Derivation of name:* *fasciculata* refers to the fasciculate costae on shell.

*Diagnosis:* A species of *Podtsheremia* characterized by its biconvex shell with rounded costae frequently branching and forming fascicles on lateral slopes, ventral sinus with a simple median costae and branching costae, dorsal fold bearing a median furrow, and rows of denticles along hinge.

*Description: Exterior.* Shell triangular in outline, transverse, mucronate, widest at hinge; mucros flat to slightly concave, well developed in small specimens; radial costae, fine lirae and concentric growth lines forming shell ornament; 20 to 23 fasciculate costae on each steep lateral slope, 6 to 7 simple costae on postero-lateral extremities, fascicles of 3 to 4 ribs on either side of ventral sinus and dorsal fold. Pedicle valve with a moderate and incurved umbo, a flat to weakly concave apsacline interarea ornamented with faint horizontal and vertical striations; delthyrium open, with an angle of 68°; sinus shallow, reaching umbo; sinal angle about 19°. Brachial valve with a short umbo overhanging a narrow interarea; fold costate, conspicuous.

*Interior.* Pedicle valve with high and sharp dental lamellae, supporting elongate teeth; denticles arranged in rows on either side of base of a shallow delthyrial cavity, oriented perpendicular to hinge; adminicula short and sharp, diverging at 10°-12°; adductor scars narrowly elongate, finely striated, and divided by a weak myophragm; diductor scars also elongate, smooth but faintly striated posteriorly; two ridges ill-defined between the two muscle scars; vascula genitalia observed on lateral sides of muscle field. Brachial valve with shallow sockets, distinct inner socket ridges diverging at 82° and terminating short crura; cardinal process supported on these ridges, containing up to 18 tiny vertical plates; adductor scars of two pairs: lateral pairs subtriangular; median pairs quadrangular, well impressed, divided by a fine median ridge; the two pairs being smooth, separated by two ridges corresponding to furrows which border external fold.

*Measurements:* Length of shell: 12mm-17mm; width of shell: 17mm-27mm.

*Remarks:* When compared with the type species, *Podtsheremia prima* Kalashnikov (1966) from northern Urals, U.S.S.R., *P. fasciculata* has a more transverse shell with a hinge reaching its maximum width and mucronate cardinal extremities. *P. ? humilicostata* and *P. ? thomasi* Roberts (1971) from the Bonaparte Gulf Basin, northwestern Australia, are distinguished from the present species by their fewer costae on lateral slopes and larger angle of adminicula. In addition, *P. ? humilicostata* has a smaller delthyrial angle, but a larger sinal angle; *P. ? thomasi* has a larger angle of inner socket ridges and more numerous vertical plates in the cardinal process.

## Family BRACHYTHYRIDIDAE Fredericks 1919 (1924)

Genus *BRACHYTHYRIS* McCoy 1844

*Type species: Spirifera ovalis* Phillips 1836.

*Brachythyris cobarkensis* sp. nov.

Fig.5, 15-21

*Material*: NUF 4225-4243; holotype NUF 4234, paratypes NUF 4231, 4232 and 4243, from NUL 517 (the type locality) and 515 in the Berrico Creek Formation at Rawdon Vale.

*Derivation of name*: After Cobark River in Rawdon Vale.

*Diagnosis*: A species of *Brachythyris* with a parasulcate anterior commissure, broad ventral muscle field from which radiate strongly developed pallial markings, robust dental ridges supporting heavy teeth, large socket plates attached to subtriangular cardinal process.

*Description*: *Exterior*. Shell unequally biconvex, with 10-12 broad and flat plicae on each lateral slope and developed concentric growth lines; plicae bifurcating, simple on cardinal extremities. Pedicle valve strongly convex on umbonal region; umbo erect, small, sharply pointed; cardinal areas broad and concave; delthyrium open, triangular, wider than high; delthyrial angle  $63^\circ$ ; sinus shallow, reaching umbo, costae in sinus not observed, sinal angle about  $9^\circ$ . Brachial valve with a small and short umbo, a distinct fold bearing a weak median furrow.

*Interior*. Pedicle valve thickened on umbonal region; muscle scars well impressed, variable in outline, occupying about one-third valve surface; adductor scars narrowly elongate, ridged, divided posteriorly by a distinct myophragm; diductor scars broad, fusiform, having a deep posterior median furrow. In brachial valve, socket plates enclosing elongate sockets, adductor scars finely striated and divided by a weak median ridge; cardinal process having up to 32 branching, bifurcating and simple thin vertical plates; pallial markings weakly developed.

*Measurements*: Length of shell: 24mm-29mm; width of shell: 23mm-28mm.

*Remarks*: *Brachythyris solida* Campbell (1963) from the Belvue Syncline, N.S.W., is similar to *B. cobarkensis* in the width/length ratio of shell, and the strong convexity of pedicle valve towards the umbo. However, it differs in having more numerous but narrower costae on the lateral slopes, and a subtriangular cardinal process containing fewer vertical plates. *B. pseudovalis* Campbell (1957) and *B. elliptica* Roberts (1963) respectively from Babbinboon and Lewinsbrook, N.S.W., are larger and have better developed costae on the lateral slopes, weaker sinus and fold, a larger sinal angle, and more numerous vertical plates in the cardinal process. *B. planulata* Roberts (1971) from the Bonaparte Gulf Basin, northwestern Australia, is characterized by its more transverse shell, uniplicate commissure, smaller delthyrial angle, larger sinal angle, and fewer vertical plates in the cardinal process. The species described by Carter (1967) as *B. chouteauensis* (Weller) and *B. girtyi* (Branson) from the Mississippian Chapel Limestone of central Texas, exhibit better developed costae being usually simple, and lack a ventral myophragm. In addition, *B. chouteauensis* has a uniplicate anterior commissure, costate ventral sulcus and dorsal fold, smaller teeth and no developed dental ridges; *B. girtyi* has a subequally biconvex shell, narrower dental ridges and no developed dorsal median ridge. *B. peculiaris* (Shumard) described by Weller (1914) from the Mississippian Chouteau Limestone at Mississippi Valley Basin, is smaller and possesses narrower cardinal areas, a rounded ridge dividing the lateral slopes into two regions, and fewer plicae being only simple and rounded.

## LOCALITIES OF FIGURED SPECIMENS

Locality number	Grid references
NUL 514	738 453 Cobark 1:31680 Sheet

NUL 515	740 455 Cobark 1:31680 Sheet
NUL 517	736 490 Cobark 1:31680 Sheet
NUL 545	625 077 Dungog 1:63360 Sheet
NUL 628	732 499 Cobark 1:31680 Sheet
NUL 640	708 462 Cobark 1:31680 Sheet
NUL 723	737 553 Cobark 1:31680 Sheet
NUL 861	851 303 Gloucester 1:63360 Sheet
NUL 882	707 463 Cobark 1:31680 Sheet

NU = University of Newcastle

#### ACKNOWLEDGEMENTS

I am indebted to Professor B. Nashar for her continuing support, and to Associate Professor B. A. Engel for his helpful advice and critical reading of the manuscript. Facilities provided by the Department of Geology of the University of Newcastle, N.S.W., are also acknowledged.

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